

(c) Capacity and performance tests will conclude when the stored breathing gas supply has been fully expended.

(d) NIOSH will determine a CCER to have failed a capacity, performance, or wearability test if any of the following occurs:

(1) A 1-minute average measurement of any stressor listed in Table 1 occurs outside the acceptable excursion range specified in Table 1; or an average stressor measurement calculated at the completion of a performance or capacity test exceeds the acceptable operating average range specified in Table 1; or

(2) A human subject cannot complete the test for any reason related to the CCER, as determined by NIOSH.

(e) Unless otherwise stated, tests required under this subpart will be conducted at the following ambient conditions:

(1) Ambient temperatures of $23^{\circ}\text{C} \pm 3^{\circ}\text{C}$; and

(2) Atmospheric pressures of 735 mm Hg \pm 15 mm Hg.

§ 84.304 Capacity test requirements.

(a) NIOSH will conduct the capacity test on a total of 8 to 10 of the units submitted for approval, as follows:

(1) Three units will be tested on a breathing and metabolic simulator in the condition in which they are received from the applicant;

(2) Two units will be tested on a breathing and metabolic simulator after being subjected to the environmental treatments specified in § 84.307 of this subpart;

(3) Two units will be tested on a breathing and metabolic simulator at the cold-temperature limit recommended by the manufacturer under § 84.302(h)(1), after the unit has been stored for a minimum of 24 hours at this limit; and

(4) One unit, in the condition in which it is received from the applicant, will be tested by a human subject on a treadmill.

(5) To approve a CCER for use in coal mines, two units will also be tested by a human subject under the specifications of §§ 84.99 and 84.100 that are applicable to man test 4.

(b) The capacity test will begin upon the first inhalation from or exhalation into the unit.

(c) Each unit will be tested at a constant work rate, depending on the capacity value specified by the manufacturer, according to the requirements specified in Table 2. All volumes are given at standard temperature (0°C) and pressure (760 mm Hg), dry, unless otherwise noted.

(d) NIOSH will rate an approved CCER using the appropriate capacity rating, as specified in Table 2.

TABLE 2—CAPACITY TEST REQUIREMENTS

Capacity rating	Capacity (L of O_2)	VO_2 (L/min)	VCO_2 (L/min)	V_e (L/min)	RF (Breaths/ min)
Cap 1	$20 \leq L \leq 59$	2.50	2.50	55	22
Cap 2	$60 \leq L \leq 79$	2.00	1.80	44	20
Cap 3	$L \geq 80$	1.35	1.15	30	18

VO_2 = volume of oxygen consumed per minute; VCO_2 = volume of carbon dioxide produced per minute.
 V_e = ventilation rate in liters of air per minute; RF = respiratory frequency.

(e) NIOSH will document the least value achieved by the seven units tested using the breathing and metabolic simulator. NIOSH will quantify this value of achieved capacity within an increment of 5 liters, rounding intermediate values to the nearest lower 5-liter increment.

§ 84.305 Performance test requirements.

(a) NIOSH will conduct the performance test on a total of six of the units submitted for approval, as follows:

(1) Three units will be tested on a breathing and metabolic simulator in the condition in which they were received from the applicant; and

(2) Two units will be tested on a breathing and metabolic simulator

after being subjected to the environmental treatments specified in § 84.307; and

(3) One unit will be tested, in the condition in which it was received from the applicant, by a human subject on a treadmill.

(b) Except as provided under paragraph (c) of this section, the performance test will apply a repeating cycle of work rates, according to the sequence and requirements specified in Table 3, until the oxygen supply of the unit is exhausted.

(c) Testing of CCERs with less than 50 liters of capacity, as determined by the capacity testing under § 84.304, will require the submission of additional test units to fully apply the work-rate test sequence and requirements specified in Table 3. The testing of each individual unit will complete the cycle

specified in Table 3 until the breathing supply of the initial test unit is exhausted. This initial test unit will then be replaced by a second unit, which will continue the test cycle, beginning at the work rate in the cycle at which the initial unit was exhausted, and completing the full period specified in Table 3 for that work rate before proceeding to the subsequent work rate, if any, specified in Table 3. Each initial testing unit will be replaced as many times as necessary to complete the cycle, not to exceed two replacement units per initial test unit.

(d) The performance test will begin with two exhalations into the unit at the specified ventilation rate and then follow the manufacturer's instructions to determine the design's susceptibility to hypoxia upon initial donning.

TABLE 3—PERFORMANCE TEST REQUIREMENTS

Work-rate test sequence	Duration per cycle (in minutes)	VO ₂ (L/min)	VCO ₂ (L/min)	Ve (L/min)	RF (breaths/min)
1. Peak	5	3.00	3.20	65.0	25
2. High	15	2.00	1.80	44.0	20
3. Low	10	0.50	0.40	20.0	12

VO₂ = volume of oxygen consumed per minute; VCO₂ = volume of carbon dioxide produced per minute.
Ve = ventilation rate in liters of air per minute; RF = respiratory frequency.

§ 84.306 Wearability test requirements.

(a) NIOSH will conduct the wearability test on a total of three of the units submitted for approval. Three human subjects (two males and one female), one subject per unit, will conduct the test. The three subjects will range in height and weight as follows: One subject of height ≥174 cm and weight ≥90 kg; one subject of either 163 cm ≤ height <174 cm, regardless of weight, or 72 kg ≥ weight <90 kg, regardless of height; and one subject of height <163 cm and weight <72 kg. All units tested must meet all conditions specified in this section to receive approval.

(b) NIOSH will evaluate the ease and speed with which users can don the CCER, as follows:

(1) Each test subject will be provided with manufacturer instructions, and must be able to don the CCER cor-

rectly, isolating the lungs within 30 seconds;¹ and

(2) A CCER must not include any design, construction, or material characteristic that can be anticipated or demonstrated, under plausible conditions, to hinder the user in the correct and timely donning of the CCER.

(c) NIOSH will continuously monitor CCER use by each test subject during the activities specified in Table 4 to evaluate the ability of the CCER to provide an adequate and uninterrupted breathing supply, including but not limited to the requirements of § 84.303(b), without harming or hindering a user. NIOSH will not approve a CCER if the use of any unit during these activities indicates any potential for the CCER to harm or hinder the user or to fail to provide an adequate

¹This time limit does not apply to any additional steps that might be required after the lungs are protected to adjust the unit for wear.